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The Southern Headwaters At Risk Project: A Multi-Species Conservation Strategy for the Headwaters of the Oldman River

Volume 5

Landscape Pressures on Wide-Ranging Species

Alberta Species at Risk Report No. 107

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

Alberta Conservation Association

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Landscape Pressures on Wide-Ranging Species

By

François Blouin

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EXECUTIVE SUMMARY

The Southern Headwaters at Risk Project (SHARP) is a multi-species approach to the management and conservation of species at risk in the headwater region of the Oldman River in southwestern Alberta. As such, SHARP includes different components to encompass the variety of species affected within the project area and to identify their specific requirements and the threats that are limiting to them. This component of SHARP focuses on selected wide-ranging species in the study area, which includes large carnivores and ungulates, smaller mammals with wide home ranges, and a raptor, and identifies the landscape pressures that are threatening their survival and sustainability.

The major threats facing the wide-ranging species in the southern headwaters area are habitat loss, degradation, and alteration. Human population growth is placing increasing landscape pressures on the wildlife populations through human-caused disturbances such as infrastructure development (*e.g.* transportation, water management, industrial) and activities that include resource extraction, agriculture, and recreation. These activities have a direct impact on the landscape and subsequently impact the species that rely upon the landscape to meet their specific life requirements.

This volume of the SHARP report describes selected wide-ranging species found within the project area and outlines the landscape pressures pertinent to each, discusses some of the current initiatives that have been undertaken to minimize human pressures on their habitats and populations, and offers some recommendations for continued and further mitigation measures.

1.0 INTRODUCTION

In addition to the focal species investigated under the Southern Headwaters At Risk Project, wide-ranging species are particularly vulnerable to landscape pressures brought about by the growth of human populations. Wide-ranging species, especially large carnivores, often occur at low densities, have a low reproductive capacity (fecundity), have restricted dispersal ability in a human-disturbed environment, and other life-history traits that limit resilience to these disturbances (Weaver *et al.* 1996, Claar *et al.* 1999). Current nature reserves are often too small to ensure the long-term survival of these area-demanding species and populations (Paquet and Hackman 1995, Noss *et al.* 1996), which must also rely on remaining unprotected wild lands to sustain their populations. Pressures affecting these lands make wide-ranging species highly susceptible to local and regional extinction.

The most serious threat impacting the survival of wide-ranging and other species worldwide is habitat loss, degradation, and fragmentation (Wilcox and Murphy 1985, Meffe *et al.* 1997, Huxel and Hastings 1999). In the southern headwaters area, pressures from human infrastructure development (transportation, industrial, settlement, water management, recreational) and activities (resource extraction, agriculture, hunting, and recreation) contribute singly or cumulatively to alienate natural habitats of wide-ranging species (Brooks 1997, Sawyer *et al.* 1997).

Fragmentation creates remnant vegetation patches embedded in a matrix of different vegetation (Eng 1998). In addition to the outright loss of habitat, the degree of isolation of remaining fragments through distance, nature of surrounding matrix (Ricketts 2001), and loss of connectivity (Eng 1998), may have a significant effect on the movement and hence population viability of wide-ranging species (Sawyer *et al.* 1997, Ray 2000). Habitat effectiveness may also be reduced in remaining fragments through reduction or loss of interior conditions and/or habitat area (Ray 2000), and through an increase in shape complexity (edge effect; Eng 1998). Indirect consequences of habitat fragmentation on wide-ranging species include a shift in species composition, with an expansion in more generalist species that bring about new diseases and an increase level of competition within a relatively short period (Hunter 1990, Goodrich and Buskirk 1995, Oehler and Litvaitis 1996, Ray 2000). The more specialized species are in their resource requirements, the most vulnerable to this type of ecological change (Ray 2000). In addition, the encroachment of human activities and settlement on large carnivores inevitably results in direct conflicts, where the animal causing the conflict usually loses.

The following wide-ranging species occurring in the southern headwaters area are potentially impacted by human activities and development. Claar *et al.* (1999) and Canfield *et al.* (1999) provided a review on the effects of recreation on Rocky Mountain carnivores and ungulates, respectively, with an emphasis on Montana. Jalkotzy *et al.* (1997) reviewed the effect of linear development on wildlife. These reports informed much of the species accounts that follow. The reader is directed to them for more detail and for the original references.

2.0 COUGAR/ MOUNTAIN LION

In comparison to other large carnivores in North America, the cougar (*Puma (Felis) concolor*) is rather resilient to environmental disturbance, due to its plasticity in prey selection, high female survivorship, relatively high reproductive capacity and success at dispersing into new areas (Weaver *et al.* 1996).

In southwestern Alberta, cougars were found to feed largely on ungulates. Deer made up 39% of their prey items, followed by moose 23%, and elk 16% (Alberta Fish and Wildlife Division 1992). More minor prey species included bighorn sheep, porcupine, snowshoe hare, beaver, coyote, spruce grouse, domestic dog, and other cougars.

Factors affecting productivity of cougars include longevity, age at first breeding, reproductive interval, litter size, and longevity. Most of the information on Alberta cougars comes from a harvested population in the Sheep River area (Alberta Fish and Wildlife Division 1992). Females bred for the first time at age 2-4 and had a reproductive interval of 19 months. Litter size at 6 months of age was on average 2.2 young. Cougars generally live less than 12 years old in the wild (Pattie and Hoffmann 1999), but in Oregon, some were recorded living up to 17 years old (Oregon Department of Fish and Wildlife 2005).

In southwestern Alberta, mean annual home range for females and males were 140 ± 13.7 km^2 (SE) and 334 ± 37.1 km^2, respectively (Ross and Jalkotzy 1992). Dispersal distances for juveniles ranged from 30 to 155 km, but juvenile females often established home ranges adjacent to and occasionally overlapping their mothers' home range (Ross and Jalkotzy 1992). In the southern headwaters area, density estimates vary from 3.5 to 4 cougars/100 km^2 in the mountain and the foothill regions, respectively (Alberta Fish and Wildlife Division 1992).

2.1 Landscape Pressures

Fragmentation and alienation of cougar habitat by human disturbance and footprint is thought to be the greatest threat to the long-term sustainability of cougar populations (Claar *et al.* 1999). Cougars avoid areas with excessive noise, lighting, and domestic dogs, but will travel in areas where isolated residences without lighting, quiet motors, and trails heavily used by equestrians, hikers, and bicyclists are found (Claar *et al.* 1999). In the Sheep River area of Alberta, high density of radio locations for female cougars in summer were significantly associated with greater distances from all high (200-500 users/month) human use in a high-use recreational area. Male radio locations in summer and winter were significantly associated with greater distances from high human use trails (Jalkotzy *et al.* 1999). In this area (Jalkotzy *et al.* 1997), as well as in Utah and Arizona, and Texas, cougars shifted their period of activity to times of low human use (Claar *et al.* 1999). In addition, resident cougars in Utah and Arizona were rarely seen in or near (< 1 km) recently (< 6 years) logged areas (Jalkotzy *et al.* 1997).

Dispersing subadult cougars may be more vulnerable to disturbance. In Utah and Arizona, recently independent subadults in search of home ranges were more likely to encounter human disturbance than did resident cougars. Unoccupied areas were found more often in proximity to human development (Van Dyke *et al.* 1986).

Increased road access may act as filters or barriers to cougars and limit their dispersal abilities (Jalkotzy *et al.* 1997, Claar *et al.* 1999). The width of a roadway and the amount of traffic on it appears to dictate how much a filter it imposes to cougar movements (Jalkotzy *et al.* 1997). In Arizona and Utah, cougars established home ranges in areas devoid of or low in improved dirt roads, and crossed these roads less often than expected. They selected areas with lower road densities than the study average, but still used areas of higher road densities in absence of lower road density areas. In the Sheep River area, radio-collared cougars regularly crossed a paved road (SR 546) and other roads and trails, but this occurred more frequently between late afternoon and early morning when traffic was less (Jalkotzy *et al.* 1997). As observed in California and south Florida, small populations of this species in an environment highly fragmented by roads and other human disturbances have suffered high road mortality (Claar *et al.* 1999). Dispersing young were the most susceptible (Jalkotzy *et al.* 1997). In the East Kootenays area of British Columbia, 4 of 7 cougar mortalities recorded during a 2½-year radio-telemetry study were caused by vehicles (Jalkotzy *et al.* 1997).

In addition to vehicle mortality, roads increase access to legal and illegal hunters in cougar habitat, further increasing their probability of being killed. In most of western Canada and United States, cougar hunting is carried out with dogs and tracking occurs from linear features such as roads and cutlines (Jalkotzy *et al.* 1997). In Alberta, cougar harvest is directly related to the degree of motorized access present in an area (Jalkotzy *et al.* 1997).

Recreational hunting is usually the greatest source of mortality for cougars (Claar *et al.* 1999). In their Sheep River study of southwestern Alberta, Ross and Jalkotzy (1992) found that sport hunting was responsible for 63% (n= 27) of all known cougar mortality, and 100% of subadult males (n= 5) mortality between 1981 and 1989. In addition to the intended mortality of adult cougars, kittens may be orphaned when hunters fail to identify the lactating status of females (Ross and Jalkotzy 1992, Claar *et al.* 1999). Mortality of orphaned kittens may be high and go undetected (Barnhurst and Lindzey 1989).

3.0 CANADA LYNX

The Canada lynx (*Lynx Canadensis*) is a specialist predator of snowshoe hares. As such, its ecology varies temporally with hare densities (Koehler and Aubry 1994, Mowat *et al.* 2000). In northern areas, snowshoe hare populations undergo approximate 10-year fluctuations in abundance, typically with an amplitude of 10 to 20 folds (Hodges 2000). Lynx populations can reach high densities but undergo dramatic fluctuations in delayed synchrony with its main prey, the snowshoe hare (Apps 2004). A 3 to 17-fold variation in lynx numbers typically occurs throughout the hare cycle in the boreal forest (Mowat *et al.* 2000). Population growth is due to a high percentage of breeding females, large litters,

high kit survival, low mortality, and immigration rates that equate or exceed losses to emigration. Population decline is due to high natural mortality, increased dispersal, and collapse of recruitment and immigration (Mowat *et al.* 2000). In southern areas, where snowshoe hares occur at low densities and populations oscillate at low amplitude (Hodges 2000), the ecology of lynx populations appears to resemble that of northern populations during cyclic hare lows (Koehler 1990, Apps 2000).

Lynx home range size is impacted by snowshoe hare densities. In northern Canada and Alaska, where snowshoe hare populations follow cycles of high and low abundance, lynx home range size increases dramatically following hare crashes (Mowat *et al.* 2000). In the southern Canadian Rockies, annual home range (95% minimum convex polygon) remained relatively stable during an increase to high cyclic hare phase, averaging 277 ± 71 (SD) km^2 and 135 ± 124 km^2 for resident males and females respectively (Apps 2000). These large home ranges are thought to resemble those of northern populations during cyclic hare lows (Koehler 1990, Apps 2000).

Lynx are capable of long-distance dispersal. Straight line distances of up to 1100 km have been recorded in the northwestern part of it range (Mowat *et al.* 2000).

Lynx have a high potential for population growth. However, as with other aspects of their ecology, lynx productivity and recruitment are also highly influenced by hare abundance (Koehler and Aubry 1994). Females generally reach sexual maturity at 22 months (Koehler and Aubry 1994). In central Alberta, no litters were produced during 5 winters when hares densities were lower than 1.4 hares/ha and average litter size increased from 1.3 to 3.5 as hare densities increased from 1.8 to 5 hares/ha (Brand *et al.* 1976). In the southern Canadian Rockies where quality habitat was more patchily distributed, kit production and survival were low during increasing to high hare densities, and the apparent lack of recruitment to early winter among study animals was consistent with the more northern populations during periods of low hare densities (C. Apps, pers. comm., Apps 2000). Given that peak hare densities in the south are expected to be much closer to the minimum threshold required to support lynx, at least some southern lynx populations may be impacted by hare crash in the same winter as it occurs, and may be more sensitive to random fluctuations in hare densities that occur among years (Apps 2004). This may result in a source-sink dynamic whereas some southern landscapes support ephemeral lynx populations highly dependent on emigration from other areas, and others may act as sources for more marginal habitats with increasing prey densities (C. Apps, pers. comm., Apps 2004).

3.1 Landscape Pressures

Lynx behaviour within their home ranges in the southern Canadian Rockies was affected by the presence of highways. Lynx crossed highways less than randomly expected, suggesting that highways have a negative effect on lynx movements (Apps 2000). Although this research only looked at the effect of highways within lynx home ranges, their impact on spatial home range selection may also be important, which would decrease their apparent influence within home ranges (Apps 2000). This might be

particularly important along Highway 3 that bisects in a east-west direction the southern headwaters area.

In the contiguous United States (and similarly in the southern headwaters area), Ruggiero *et al.* (2000) suggested that habitat fragmentation in the form of increased openings, higher road densities, exurban residential development, and the increasing use of snowmobiles and other off-road devices that compact snow in areas where it is otherwise deep and soft, are likely to negatively impact lynx populations. Forest openings resulting from fire, disease epidemics, or logging, are likely to have negative short-term impacts on lynx populations, as snowshoe hare and lynx cover is removed, but are likely to have positive long-term effects as succession progresses and cover is restored (Koehler and Aubry 1994).

Much of the indirect effects of roads and urbanization on lynx populations, are largely unknown (Ruggiero *et al.* 2000). Roads developed for natural resource extraction or recreational purposes may increase the vulnerability of lynx to hunters and trappers and the potential for accidental road deaths (Koehler and Aubry 1994, Apps 2004). Complex terrain may improve lynx security in some areas (Apps 2004). In addition, the increasing number of roads and trails and the deep soft snow compaction effect of various snow devices in remote areas may facilitate access to and increase competition with other predators such as cougars, bobcats, and especially coyotes in winter (Koehler and Aubry 1994, Ruggiero *et al.* 2000, Apps 2004). However, an increase in the wolf population, as noted in the last few years in southwestern Alberta (C. Bergman, pers. comm. *cited in* Blouin 2004), may benefit the lynx, because lynx are not a major food source for wolves, and wolves might actually reduce coyote numbers through fierce interference competition (Ruggiero *et al.* 2000).

Because of their specialized nature, distinct habitat associations, low reproduction, and patchy distribution, the lynx is considered to have a low resilience to human disturbance in the southern Canadian Rocky Mountains (Apps 2004). Regional conservation of lynx and the community they depend upon requires that potential core landscapes remain productive through protection and integration of probable lynx requirements with land management at strategic and operational levels (Apps 2004).

4.0 FISHER

Data on fishers (*Martes pennanti*) in the west, and particularly in the Rocky Mountains, are scarce (Powell and Zielinski 1994). Current knowledge on fishers comes mostly from eastern Canada and United States (Claar *et al.* 1999). In the west, fishers are generally found in coniferous forests exhibiting a diversity of habitat types and seral stages (Claar *et al.* 1999). Forested riparian areas are used extensively for hunting, resting and as travel corridors. However, the structure of the forest might be more important to fishers than the species composition, as it affects prey abundance and vulnerability, and provides denning and resting sites (Powell and Zielinski 1994). Forested areas that include trees of various sizes and shapes, trees with limbs close to the ground, light gaps, snags, fallen trees and limbs, characterize the structural requirements of the fisher (Powell and Zielinski 1994).

As a generalist predator, it feeds on a variety of medium to small mammals, birds, and carrion, including porcupine, squirrels, snowshoe hare, mice, and shrews, depending on their availability (Powell and Zielinski 1994).

Fishers have relatively large home ranges. Average home range estimates are 2.7 – 40.8 km^2 for females and 15 – 85.2 km^2 for males (Claar *et al.* 1999), with estimates in the Rocky Mountains on the upper end of these ranges (Powell and Zielinski 1994; Claar *et al.* 1999). Male home ranges usually encompass one or more female home ranges. Males in particular make long distance movements (up to 163 km observed for translocated individuals; Powell and Zielinski 1994) during the breeding season (Claar *et al.* 1999).

Fishers have a low reproductive potential. Although females can breed after their first year, fishers exhibit a delayed implantation of 327-358 days, and thus do not produce young until after their second year (Claar *et al.* 1999). In a Montana study, females did not produce a litter until the age of three, and their average corpora lutea count (potential litter size) was 2.2 (Claar *et al.* 1999). Actual litter size from seven studies was in the range of 2.0 to 2.9 (Powell and Zielinski 1994). However, in eastern United States, only 58% to 63% of females that had bred either had indications of successfully producing a litter (Powell and Zielinski 1994). As a result, low-density populations may only be able to recover slowly.

4.1 Landscape Pressures

There is very limited information on fisher's ecology in the west (Powell and Zielinski 1994), and very little knowledge of the pressures that affect this species (Jalkotzy *et al.* 1997). Although generally characterized as a species that avoids humans (Powell and Zielinski 1994), in the east, fishers seem to tolerate some level of human activity and development. In eastern United States, fisher movements did not appear affected by the presence of domestic animals or human activity, including low density housing, farms, roads, gravel pits, and small scale logging operations (Claar *et al.* 1999). However, in immediate presence of a human, fishers rarely linger (Jalkotzy *et al.* 1997).

Human activities may indirectly affect fisher populations through loss of high quality habitat, fragmentation and isolation of habitats, and increased human access (Claar *et al.* 1999). In the west, fishers appear to be closely associated with late seral forests. Removal and fragmentation of these forests contributes to alienate fisher habitat and isolate populations (Powell and Zielinski 1994). Even in intact forests, large openings and non-forested areas are usually avoided by fishers (Jalkotzy *et al.* 1997). It is estimated that large scale logging operations that remove overstory canopy from areas larger and more extensive than natural windthrow and fire would result in habitat loss for fishers (Powell and Zielinski 1994). Increased human access through increased road densities or use of off-road vehicles and snow compacting devices in fisher habitat, may result in increased mortality through increased trapping opportunities, and may facilitate access to potential competitors and predators that would otherwise be excluded from the area (Claar *et al.* 1999).

Together with logging, trapping has had an important impact on fisher populations throughout its range (Powell and Zielinski 1994). Their ease of trapping either as a target or as an incidental species, combined with its low reproductive capacity, makes the fisher particularly vulnerable to this kind of activity and susceptible to overharvesting (Powell and Zielinski 1994, Claar *et al.* 1999).

5.0 AMERICAN MARTEN

Habitat requirements for the marten (*Martes Americana*) are similar to that of the fisher (Buskirk and Ruggiero 1994). They are closely associated with late-seral stands of mesic conifers, especially those with complex physical structure near the ground (Buskirk and Powell 1994).

Home range estimates for the American marten vary between 0.8 and 18.3 km^2 for males, and 0.7 and 9.1 km^2 for females (Buskirk and Powell 1994, Claar *et al.* 1999). Male home ranges are about 1.9 times those of females (Buskirk and Powell 1994). However, variation in estimates is partly an artifact of the methods used to calculate home range size in the different studies, and is also affected by the geographic location, sex, and prey abundance (Buskirk and Powell 1994). Home ranges overlap between sexes, but are exclusive among sexes (Buskirk and Powell 1994).

Martens have low reproductive rates and high longevity from a mammalian standard. Females first mate at 15 months and produce their first litter at 24 months of age (Buskirk and Powell 1994). They can live to about 15 years in the wild and there is evidence of age-dependent litter size, with peaks at 6 years and senescence at > 12 years (Buskirk and Powell 1994). The mean litter size is 2.85 (Buskirk and Powell 1994). For a 1 kg mammal, martens may be slow to recover from population-level impacts (Buskirk and Powell 1994).

5.1 Landscape Pressures

Martens generally avoid areas lacking overhead cover (Jalkotzy *et al.* 1997). In northern Alberta, pipeline right-of-ways cleared of vegetation acted as filters for marten movements. When martens approached the right-of-way, they crossed 50% of the times (Jalkotzy *et al.* 1997). However, they did not appear affected by the 1-2 m newly cut heli-seismic lines in the northern Rocky Mountain of British Columbia (Jalkotzy *et al.* 1997). Non-forested habitats above the treeline are commonly utilized during the summer in mountainous areas, but areas ≥ 5 km and devoid of trees below the lower elevational limit of trees are believed to act as a complete barrier to marten movements (Jalkotzy *et al.* 1997). Martens have been observed to cross openings of 10-100 m in size (Jalkotzy *et al.* 1997). In Colorado, martens stayed within 23 m of forested areas (Jalkotzy *et al.* 1997). Martens generally avoid clearcut areas for several decades and populations decline after clearcut logging (Buskirk and Powell 1994). In their review of literature on the duration of the negative effect of clearcutting on martens, Thompson and Harestad (1994) concluded that regenerating stands in the first 45 years post-cutting supported 0-33% of marten population of the nearby uncut forest. The removal of overhead cover, large-

diameter coarse woody debris, and, the conversion of mesic sites to xeric sites as a result of clearcutting, with the associated changes in prey communities, are the mechanisms by which martens are affected by timber harvesting (Buskirk and Powell 1994).

Overall, little data is available to understand the landscape pressures affecting the American marten. It is likely affected to some extent by the same pressures affecting other mustelids such as the fisher and the wolverine (Claar *et al.* 1999). According to Buskirk and Ruggiero (1994), its specialization for mesic and structurally complex forests; its low population densities; its low reproductive rate for a mammal of its size; and its vulnerability to trapping, predispose the marten to impacts from human activities. On the other hand, its smaller body and its more favourable life history traits with respect to other larger bodied carnivores provide it with a greater conservation advantage (Buskirk and Ruggiero 1994).

6.0 BLACK BEAR

Black bears (*Ursus americanus*) are opportunistic omnivores that take a variety of food items such as succulent early growth stage of plants, insects, animal carrion and prey (Pelton 1982, Kolenosky and Strathearn 1987, Holcroft and Herrero 1991). The patchy and scattered nature of important food sources such as mast crops (nuts, acorn, and berries) is reflected in their home range size and movements (Claar *et al.* 1999).

Black bear movements are dictated by the availability of food. As a result, home range sizes overlap among individuals and vary widely from season to season and between years (Claar *et al.* 1999). Home ranges for marked black bears in Montana were estimated between 137 and 583 km^2 for males, and 36 and 355 km^2 for females, with larger home ranges observed on the more xeric and less productive Rocky Mountain Front (Claar *et al.* 1999). Subadult males make large dispersal movements in unfamiliar habitats, which sometimes put them at a great risk of being killed by adult males, hunters, or of dying of malnutrition (Claar *et al.* 1999). Subadult females may establish home ranges within or near their maternal range (Alberta Fish and Wildlife Services 1993, Claar *et al.* 1999).

Black bears have a low reproductive potential. In Montana, females bred at age 4-6 but did not successfully produce cubs until age 6-7 (Claar *et al.* 1999). Furthermore, bears exhibit delayed implantation of the fertilized egg and gestation lasts about 220 days (Claar *et al.* 1999). Following a fall of poor mast production, females generally exhibit a "skip" in their reproductive cycle, where implantation does not take place (Claar *et al.* 1999). In addition, female black bears in western North American breed only every 2.2 or more years (Claar *et al.* 1999). Average litter size in Montana varied between 1.6 and 1.8 (Claar *et al.* 1999). Black bears in Alberta can live well into their 10-20 years of age or beyond (Alberta Fish and Wildlife Services 1993).

6.1 Landscape Pressures

It has been estimated that more than half of the mortality experienced by North American bear populations was attributable to sport hunting of black bear, and that hunting harvest actually limits population size (Claar *et al.* 1999).

Vulnerability of black bear populations to hunting varies with the amount of cover and the levels of access. In areas with a large density of roads and limited amount of escape cover, black bear are more vulnerable to hunting (Claar *et al.* 1999). Vulnerability of individual bears also varies with sex and age. With their greater dispersal movements, subadult males are the most vulnerable to hunting (Claar *et al.* 1999). Males also come out of hibernation earlier than females and enter later. They are therefore "available" to hunters longer. In addition, adult males have larger home ranges and may be less wary of humans than females, making them more vulnerable to hunters (Claar *et al.* 1999).

Roads and other linear developments and the amount of traffic on them may act as filters or as complete barriers to black bear movements. In northwestern Montana, black bear avoided areas within 274 m of roads and trails in the spring, and areas within 914 m of roads and trails in the fall (Jalkotzy *et al.* 1997). However, in southwestern Alberta, a researcher assessing distance to roads of bear sign and telemetry locations did not detect any differences with random points (Jalkotzy *et al.* 1997). In North Carolina, busy highways were used less frequently than low use roads, and primary roads were used less frequently than secondary (unpaved roads). The crossing frequency was found to be inversely proportional to traffic volume, which was influenced by the time of the day and the season (Jalkotzy *et al.* 1997). In Michigan, the range of several female black bears was delineated by major highways, indicating an avoidance of highways (Jalkotzy *et al.* 1997).

Increasing road densities may affect black bear behaviour. Two studies in Idaho reported that black bear might react to an increase in road densities by shifting their home range to areas of lower road densities (Claar *et al.* 1999). It is unknown what the threshold level of road density is for black bears. Under certain threshold levels, black bears appear to be able to adjust their movement pattern to minimize the dangers associated with traffic. Above those levels, bears modify their home range to avoid areas of high traffic (Jalkotzy *et al.* 1997). In North Carolina, it was suggested that a density of 1.25 km/km^2 of open road, and 0.5 km/km^2 of logging-road interfered with black bear use of habitat (Jalkotzy *et al.* 1997).

Industrial development may also alter black bear habitat in several ways. A comparative study looking at the numbers, sex, and age structure of bear cohorts did not detect any significant differences before and during oil extraction and transport facilities development in east-central Alberta (Tietje and Ruff 1983). In general, the size or location of radio-collared bears' home range was not altered in response to the establishment of oil sites. However, two individuals did modify the location of their home range. In addition to the direct loss of habitat associated with the structure of a road or other linear features associated, or not, with industrial development, habitat quality

may also be reduced (at least temporarily) due to soil disturbance during the construction phase (Jalkotzy *et al.* 1997). Data from Tietje and Ruff's (1983) study suggested that the secondary impacts associated with oil extraction, such as road creation, increased legal and illegal bear hunting, and human habituation, were likely more important than the actual loss and degradation of habitat (Claar *et al.* 1999). Seeding of roads and pipeline right-of-ways with crop species may also temporarily enhance habitat for black bears (Alberta Fish and Wildlife Services 1993). However, the increased risk of mortality associated with increased access (see above) may offset this benefit (Jalkotzy *et al.* 1997). Roads and railroads are also direct sources of mortality for black bears. The frequency of reported black bear mortalities due to collisions exceeds that of grizzly bears, presumably because black bears distribution overlaps more areas of higher human use (Jalkotzy *et al.* 1997).

Development and recreational activities in bear habitat may modify bear behaviour and result in bear-human conflicts (Heuer 1993). Bears that encounter several people regularly without being harmed or getting food from them can become habituated to humans and tolerate them at a closer distance than those that do not. Habituated bears that also get food from people's garbage, pets, barbeques, and campgrounds, livestock carcasses, or other human sources, form an association between food and people and become "food-conditioned" (Herrero 2003). Due to their proximity to people and their lack of wariness, human habituated and human food-conditioned bears are more likely to come into conflict with people. This puts them at a greater risk of being removed or being killed as "problem wildlife". It also increases their probability of being killed by legal and illegal hunters or becoming road-killed (Herrero 2003).

Human-bear conflicts also arise from interactions between bears, livestock, and their owners. In southwestern Alberta, livestock grazing occurs both on private and on public lands. Public lands in the southern headwaters area occur largely in the Alpine and the forested Subalpine natural subregions, but are also important in the Montane and the Foothills Parkland subregions (Figure 1). In an assessment of cattle loss to predation in Alberta between 1974 and 1978, Dorrance (1982) found that the relative susceptibility of cattle to predation increased with forest cover, was accentuated by rugged topography, and thus was highest in the foothills and mountains ecosystem. Black bears were considered responsible for 31% of the 1520 cattle confirmed killed or wounded during that period. Calves made up 71% of cattle killed by black bears, and yearlings accounted for another 11% (Dorrance 1982). Horstman and Gunson (1982) found that 39% of livestock losses in Alberta for which black bears had been blamed in 1974 – 1979 were actually animals that had gone missing. Over the same period, only 37% of the 1204 black bear-livestock complaints investigated by Alberta Fish and Wildlife officers could be linked to black bears. Horstman and Gunson (1982) estimated that approximately 0.02% of the 680,000 cattle, 0.11% of the 18,000 sheep, and 0.02% of the 80,000 swine occurring in black bear habitat in the province were lost to black bear.

Black bear shooting mortalities due to actual or perceived threats to livestock and property are considered high by the province, but kills are unregulated and unrecorded (Alberta Fish and Wildlife Services 1993). On private land in the Crowsnest Pass corridor

and in the areas surrounding the C4 and C5 Forest Reserves and Waterton Lakes National Park, livestock are common, often occur in concentration, give birth to their young, and are often supplemented with forage (e.g. forage with molasses) attractive to bears (Horejsi 2004). Even though not all bears present in the area exploit these attractants, the majority of them are perceived as a threat by cattle owners (Horejsi 2004). It is legal in Alberta for landowners or their designates on private lands, and for lessees on public lands, to hunt black bears (Alberta Fish and Wildlife Services 1993). This pressure appears important in the southern headwaters area as black bears are considered uncommon by the provincial government and represent less than 1% of the total black bear population in the province, due largely to shooting by landowners, cattle ranchers, sport hunters, and possibly predation by grizzly bears (Alberta Fish and Wildlife Services 1993).

On public lands that make up the Green Zone in southwestern Alberta, Horejsi (2004) believes that the impacts of cattle grazing on bear habitat is much more important than the actual direct conflicts with cattle or their owners. During 1974-1979, it was estimated that only 25% of all compensated cattle losses to black bear occurred on grazing leases in the Green Zone of the province where over 180,000 cattle were present (Horstman and Gunson 1982). However, only 28 claims for lost cattle were confirmed kills by this species. On the other hand, grazing of cattle on public lands has likely substantially depressed bear habitat effectiveness (Horejsi 2004). Horejsi (2004) considers that this resulted from an underestimation of cattle allocation by the provincial government versus actual cattle use, the lack of consideration of bear requirements for food and cover in the grazing and land use plans and in carrying capacity estimates, and the lack of adjustments in stocking rates during drought years (Horejsi 2004).

Horejsi (2002) summarized the impacts of livestock production on bears into two broad categories:

1) Mortality impacts:
    a. Direct killing of bears by landowners or grazing lessees due to real or perceived depredation of livestock, threats to human safety in areas of agricultural activities, or bear attractants, such as bone yards, intensive livestock operations, and garbage, that often draw bears from long distances,
    b. Relocation of bears (for the reasons noted above), which may eventually result in their death elsewhere upon re-offense (Alberta Fish and Wildlife Services 1993), encounter with a local bear or a hunter, or starvation in the new unfamiliar area.
2) Ecological impacts:
    a. Habitat degradation; including introduction of alien plants, competition for important bear food, reduction in cover and associated decline in security, and impacts on populations of mammals, fish, and birds that are or were a natural part of bear ecology,

b. Habitat destruction where some natural features important to bears are destroyed or altered,

c. Alienation of suitable habitat through avoidance of humans by wary bears.

Black bears may also be negatively impacted by forest maturation or by timber harvesting. Effective fire suppression ongoing since the early 1900s (Murphy 1985) has resulted in a predominance of overmature (> 120 years old) and mature (81-120) forests in the Eastern Slopes of Alberta (Alberta Fish and Wildlife Services 1993). This has decreased habitat effectiveness for black bear in the area. Although some timber harvest regimes may increase the quality and carrying capacity of bear habitat, the simultaneous increase in vulnerability to hunting due to increased access in a highly hunted population may outweigh the benefits (Brody and Stone 1987). When fires do occur, they are much more catastrophic because of fuel accumulation that results from unnatural return intervals. The Lost Creek fire that burned in the area in 2003 may have further reduced the habitat effectiveness for this species, at least in the short term. Such hot duff-consuming fires can destroy shallow rhizomes from berry-producing shrubs (Hall and Shay 1981). These must re-establish through seed dispersal or rhizomes that escaped lethal temperatures (Hall and Shay 1981) and best production is found on sites that burned 25 – 60 years previously (Snyder 1991). Moreover, the female and subadult segment of the black bear population may decline and survival of cubs to the yearling age-class may also be compromised in the short term (at least four years) in a burn area the size of the Lost Creek fire (Cunningham and Ballard 2004).

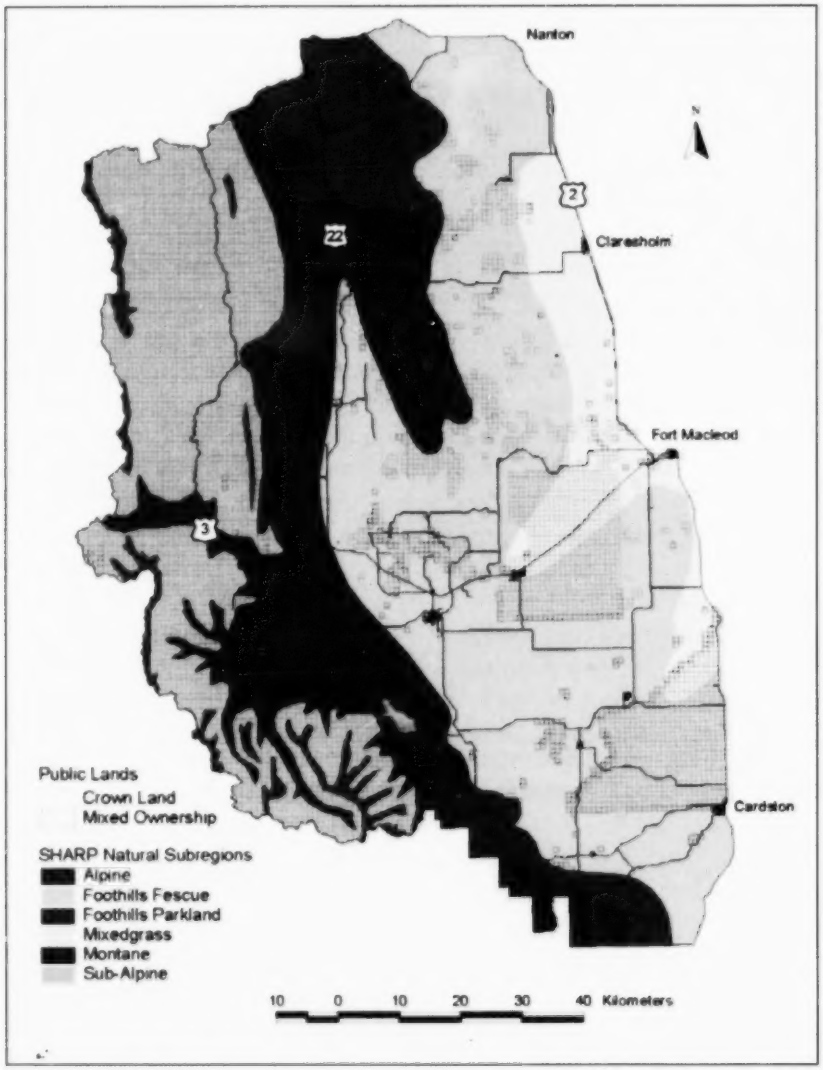

Figure 1. Distribution of public lands in the southern headwaters area.

7.0 GRIZZLY BEAR

Grizzly bear (*Ursus arctos*) were not assessed in this exercise as a recovery plan has been developed for the species that addresses the various landscape pressures it faces in the province. The plan is currently awaiting approval by the Minister of Sustainable Resource Development (D. Hobson, pers. comm.).

8.0 GRAY WOLF

With their high annual productivity and dispersal capabilities, wolves (*Canis lupus*) are likely the most resilient large carnivores to modest levels of human disturbance of habitat and populations (Weaver *et al.* 1996). Wolves in the wild typically breed after 22 months of age. In Alberta, they produce 4-7 pups (average 5) per year, with less than half of them surviving to their first mid-winter (Alberta Fish and Wildlife Division 1991). Due to their predacious nature and the danger associated with preying on large mammals, they rarely live longer than seven or eight years in the wild (Alberta Fish and Wildlife Division 1991).

Wolves are highly mobile species and capable of long dispersal movements (Claar *et al.* 1999). Very long dispersal movements were observed between Minnesota and Saskatchewan (886 km), and Northwest Territories and central Alberta (670 km) (Alberta Fish and Wildlife Division 1991). Wolf density and prey abundance appear to dictate the nature, role, and extent of wolf dispersal (Alberta Fish and Wildlife Division 1991). Wolves disperse at age 9-28 months or more, and dispersal of yearlings in the fall is common (Alberta Fish and Wildlife Division 1991).

Wolves make extensive movements in search of prey or for dispersal. The size of a wolf pack territory is highly variable and is influenced by the number of wolves in the pack and the abundance of prey in the area (Mech 1981). The greater the prey base, the smaller wolf pack territories are (Fuller 1989). Territories have been reported to range in size from 49-135 km^2 for a pack of five in Minnesota (Van Ballenberghe *et al.* 1975) to 2455 km^2 for a pack of 14 in western Alberta (Schmidt and Gunson 1985), and up to 4000 km^2 in Denali National Park, Alaska (Mech *et al.* 1998). Territories are largest where prey species are migratory (Alberta Fish and Wildlife Division 1991). Territories also vary seasonally, with smaller territories during the denning and pup-rearing period, and larger territories during winter (Alberta Fish and Wildlife Division 1991).

Gray wolves are opportunistic predators that feed on white-tailed deer, mule deer, caribou, moose, elk, mountain goat, bison, and bighorn sheep, and domestic ungulates such as horses, sheep, and cattle in Alberta (Alberta Fish and Wildlife Division 1991, Gunson 2002). They also take other prey species such as beaver, snowshoe hare, and microtines when available. The east front of the Rocky Mountains in the southern headwaters area is home for large populations of deer (*Odocoileus* spp.) and is the wintering grounds for thousands elk (*Cervus elaphus*) that congregate in the area (Ream and Harris 1986). These form an important prey base for the wolf population in the area.

Satellite telemetry data gathered on wolves during the winter of 2004, combined with sighting and occurrence data strongly suggested that, at least during the early and mid season, stable packs (i.e. groups larger than five that occupied distinct and separate territories) were present from the southern to northern boundary of the southern headwaters area (C. Bergman, pers. comm. *cited in* Blouin 2004).

8.1 Landscape Pressures

Wolves are intelligent animals that learn quickly and show high behavioural plasticity. As a result, individual show a wide variation in adaptability and respond differently to human disturbances (Claar *et al.* 1999). However, their persistence in an area depends on two important habitat components: 1) an adequate year-round supply of ungulates, and 2) absence of excessive human persecution (Claar *et al.* 1999). Telemetry, sighting, and occurrence data from winter 2004 indicate that current wolf territories in the southern headwaters area appear to be in alignment with winter elk distribution (C. Bergman, pers. comm. *cited in* Blouin 2004). Winter range of ungulates in the Rocky Mountain is often located in valley bottoms with lower snow depths (Claar *et al.* 1999). These are also areas that are the most susceptible to the creation of transportation corridors and other human developments, and the more prone to recreational activities and other human use. In the northwestern section of the southern headwaters area, it was estimated that less than 14% of the area was very high quality habitat for wolves, and most of it occurred in lower elevation (< 1850 m) valley bottoms (Sawyer *et al.* 1997). This is also where human activities were concentrated.

Depending on their scale and intensity of use, roads and other anthropogenic linear features (e.g. seismic lines, ORV, snowmobile, or cross-country trails) can either be harmful or beneficial to wolves. The ease of travel of some of these features is attractive to wolves that may select preferentially as travel routes (Claar *et al.* 1999). However, the risk of unnatural mortality is also increased through vehicle collision, and increased access to hunters, trappers, and poachers (Jalkotzy *et al.* 1997, Claar *et al.* 1999). In Banff National Park, 15 out of 27 wolf mortalities were caused by vehicle collision (Claar *et al.* 1999). In the central Rocky Mountains, 21 out of 25 human-caused wolf mortalities occurred within 200 m (shooting distance) of a human linear feature (Claar *et al.* 1999). Heavily used roads may also act as barriers and alienate wolves from areas that would otherwise be suitable. In the Bow River valley, wolves were estimated to avoid about 62% of the best wolf habitat due to disruption from roads and other linear and punctual developments and human presence (Jalkotzy *et al.* 1997). Road density also appears to have an important impact on wolf population persistence in an area. Studies conducted in central North America indicate that wolves tend to avoid areas with road (accessible to two-wheel-drive) densities greater than 0.6 km/km^2 (Jalkotzy *et al.* 1997).

Wolf response to disturbance at den or rendezvous sites is highly variable. Although some wolves that have been habituated to human activity will tolerate some level of human disturbance close to their dens and offspring (Thiel *et al.* 1998), others that live in a more "wilderness" setting appear less tolerant. Disturbance at den or rendezvous sites may negatively affect reproductive success (Claar *et al.* 1999). In the first three weeks of

their lives, pups are unable to regulate their body temperature and are highly dependent on the alpha female to keep them warm. Pups may be vulnerable to disturbance that keeps the alpha female away during this critical period. In addition, pups may need to be relocated to another den when disturbed, increasing their vulnerability to inclement weather, predators, or other natural hazards.

In the southern headwaters area, the greatest threat to wolves is likely wolf hunting by private individuals, as well as wolf control by wildlife management authorities in response to livestock depredation. Livestock grazing in the area, both on private and on public lands, provides an alternative source of prey for the opportunistic gray wolf, and may results in the killing of the wolves. In Alberta, it is legal for landowners, leaseholders, or any resident authorized by them to hunt wolves year-round without a license on or within eight kilometers of their land or lease (Alberta Queen's Printer 2005). In 1994, at least 24 cattle were killed or mauled by wolves in southwestern Alberta. Concerned ranchers, conservationists and governments (federal and provincial) organized cooperative wolf research and management projects, which included a wolf sighting registry, fund-raising to compensate for wolf kills of livestock, and radio-telemetric monitoring (Gunson 2002). During 2003-2004 in the southern headwaters area, two packs were linked to ongoing cattle depredation. One pack numbering 14 in the late summer 2003 was reduced by local wildlife agency staff and by landowners and private hunters to two individuals (C. Bergman, pers. comm. *cited in* Blouin 2004).

9.0 ELK AND OTHER UNGULATES

In northern ungulates, winter range is often considered the limiting factor for maintaining populations. For some elk (*Cervus elaphus*) and deer populations, there may be migration between their summer and their winter range. Moose, mountain sheep, and mountain goats generally occupy a unique geographic area year-round, while limiting their seasonal access to specific topographic niches within that area (Canfield *et al.* 1999). The southern headwaters area comprises one of the two most important elk winter ranges in Alberta (Bradshaw *et al.* 1997). The Bob Creek-Whaleback area is home to over a 1000 wintering elk (Bob Creek Wildland /Black Creek HRMPT 2003). This area is inhabited by year-round resident elk populations and by migratory populations that summer as far as interior British Columbia (Bradshaw *et al.* 1997). The main movement corridors for elk migrating to and from the Whaleback area occur along the Deep Creek, the White Creek, and the Oldman River through the Gap. However, in the vicinity of the Whaleback area, elk movements tend to occur on ridge tops rather than in valley bottoms (Bradshaw *et al.* 1997). Elk and other ungulates, such as mule deer, and to a lesser extent, white-tailed deer and mountain sheep, migrate to this key area in late fall and winter to feed on the grassy south and southwest-facing ridges and slopes that are wind-blown and virtually free of snow much of the winter (Bradshaw *et al.* 1997). The northern part of the area houses one of the greatest densities of wintering moose in North America (Bradshaw *et al.* 1997). They feed in the willow and dwarf birch communities of damp valleys, such as the Bob and Black creeks (Bradshaw *et al.* 1997).

The southern headwaters area also includes key mountain sheep ranges. Mountain sheep overwinter on some of the subalpine ridges of the Livingston Range (Bradshaw *et al.* 1997). In addition, the south-facing slopes in the Front Range of the Castle area are snow-free for much of the winter and provide critical winter habitat and some of the better year-round habitat in Alberta.

9.1 Landscape Pressures

Human developments may cause displacement of ungulates to more secure areas. In elk populations, individuals respond differently to human disturbance depending on their previous experience (Jalkotzy *et al.* 1997). In Montana, activities associated with timber harvesting and road building in areas of timber harvest open to hunting resulted in elk displacement up to 8 km from the disturbance (Jalkotzy *et al.* 1997). However, most displacement distances were just sufficient so as to break the visual contact of men and equipment (Jalkotzy *et al.* 1997). Winter recreationists, including cross-country skiers, frequently caused elk displacements, especially in heavy use areas (Ferguson and Keith 1982, Jalkotzy *et al.* 1997). In Yellowstone National Park, 75% of flight behaviour by elk occurred within 650 m of skiers (Canfield *et al.* 1999). Greater flight distances were observed in response to human on foot and skis than to snowmobiles (Canfield *et al.* 1999). In this park, elk on winter range began to move away earlier (median = 400 m vs 15 m) and moved 42 times (median) further in areas of continuous human activity compared to more remote areas (Jalkotzy *et al.* 1997). In the High River valley north of the southern headwaters area, feeding on right-of-ways and road-crossings were limited to nighttime during winter (Jalkotzy *et al.* 1997). In Rocky Mountain National Park, Colorado, elk, which received little or no hunting pressure, were visible and did not appear affected by normal on-road visitor activity. However, people approaching animals away from roads caused them to leave the open areas (Jalkotzy *et al.* 1997). However, even when disturbances are not visibly manifest, they may induce heart rate increases that result in high-energy expenditure for ungulates (Canfield *et al.* 1999).

Access roads and other linear features reduce the habitat effectiveness for elk. Modeling by Lyon (1983) showed that in the average situation elk habitat effectiveness was expected to decrease by at least 25% with a density of 0.6 km/km^2 (1 mile/mile^2), and by at least 50% with a density of 1.2 km/km^2 (2 miles/mile^2). Seventy elk were radio-tracked in a hunted population of southwestern Alberta, in a study to assess the impact of access features on elk distribution. In the Pincher Creek area, elk appeared to avoid habitat within 300 m of primary paved roads in all seasons, but avoided secondary (gravel) roads only in fall and winter (Jalkotzy *et al.* 1997). Elk avoided habitat within 200 m of transmission lines and 100 m of pipelines in winter and spring, and avoided the habitat within 300 m of these features in autumn. Elk did not appear to avoid narrower seismic lines and cutlines (Jalkotzy *et al.* 1997). In all seasons in the Castle-Carbondale area, more elk than expected were found in habitat that was >500 m from any form of access (Jalkotzy *et al.* 1997). In summer, fall, and winter, elk tended to avoid habitat within 300 m of primary roads, and 250 m of secondary roads (Jalkotzy *et al.* 1997). Elk were found closer to seismic lines and truck trail in spring than in summer, fall and winter, and observations within 250 m of these features were lower than expected in all seasons but

winter (Jalkotzy *et al.* 1997). In another study, elk exposed to trail and road traffic during the hunting season shifted their use of large grassland areas to marginal forest patches deprived of ORVs and trails (Morgantini and Hudson 1979). However, Canfield *et al.* (1999) noted that there was a lack of information concerning the relative disturbance caused by ORV traffic as compared to vehicles on open roads.

The development of anthropomorphic linear features also increases access to ungulates by legal and illegal hunters and natural predators (Jalkotzy *et al.* 1997). In north-central Idaho, 69 (57%) of the 121 radio-tracked elk died between 1986 and 1991 (Jalkotzy *et al.* 1997). Most deaths (87%) were directly associated with human hunting, including 4% that were poached. The probability of elk mortality increased with road and hunter densities, and was lowest in broken or dissected topography (Jalkotzy *et al.* 1997). Wolves (and coyotes) also take advantage of the ease of travel on linear features compacted by human (including snowmobile and cross country trails) and may reach ungulate wintering areas previously inaccessible to them (Claar *et al.* 1999).

Pressures resulting from human activities may also have more subtle outcomes by affecting factors such as fecundity and vigor in ungulate populations. In the southern headwaters area, a large portion of the Yarrow-Castle mountain sheep population was lost to pneumonia in the early 1980s (Jokinen *et al.* 2004). From an estimated 400 individuals during the 1970s, the population dwindled to less than 150 individuals within a two-year period (Jokinen *et al.* 2004). Since the crash, the population increased, but leveled-off to about 200-250 sheep by 1995. However, since 1993 there has been a continuous decline in ewe numbers, with inbreeding suggested as the proximate factor for this decline, and loss of habitat and decrease in habitat effectiveness suggested as ultimate factors (Jokinen *et al.* 2004). Cervid farming can also potentially be an important threat to the survival of wild ungulates through transmission of diseases. Chronic Wasting Disease (CWD) is a transmissible spongiform encephalopathy that can potentially affect mule deer, white-tailed deer, elk, and moose (Bollinger *et al.* 2004). In Canada, it was first detected in farmed elk that were imported from South Dakota in the late 1980s. It was later identified in 40 game farms in Saskatchewan and 3 game farms in Alberta, and in wild cervids in three relatively separated areas of Saskatchewan. An expert panel on the disease indicated that, based on its distribution and prevalence in Canada and the USA, CWD was most likely recently introduced into free-living Canadian cervids and was not part of native ecosystems (Bollinger *et al.* 2004). The source of infection of wild deer in Saskatchewan is believed to have been from a non-intentional spill-over from infected game farms (Bollinger *et al.* 2004). The panel further added that CWD had the potential to reduce wild cervid populations in the long term, which may trigger shifts in prey selection by predators and scavengers, as well as local shifts in animal-vehicle collisions, herbivory, and competition with livestock (Bollinger *et al.* 2004). Elk farming has now been established in the southern headwaters area (D. O'Hara, pers. comm.), home of one of the most important elk winter ranges in Alberta (Bradshaw *et al.* 1997).

Subtle impacts also arise from fire control policies established since the early 1900s (Murphy 1985) that have contributed to the loss of winter range for elk and other

ungulates in the southern headwaters area. O'Leary *et al.* (1989) estimated that much of the loss in grass-rough pasture cover to shrub and deciduous encroachment in the Bob Creek region occurred in areas that had been identified as primary and secondary elk wintering range. The rate of loss of the grass-rough pasture was estimated at 13.5 ha per year. An earlier study in the Livingston Range concluded that "forest encroachment over a 30 year period has significantly decreased the amount of grassland that may have been suitable for elk winter range" (Natural Resource Information Services 1986 cited in O'Leary *et al.* 1989). However, the setback in vegetation succession caused by recent fires, such as the Lost Creek fire that burned over 21,000 ha of forest in 2003, will likely have an ameliorating effect on elk and other ungulate habitat in the southern headwaters area.

10.0 GOLDEN EAGLE

The headwaters area of the Oldman River is critical to golden eagles (*Aquila chrysaetos*). Two functionally distinct populations that may be genetically different make use of the area at various times of the year (P. Sherrington, pers. comm.). One resident population uses the Montane and the Foothills Fescue Natural Subregions for nesting (data derived from the Alberta Fish and Wildlife Management Information System (formerly BSOD), AB SRD and ACA 2003). The area is also of continental significance for the migratory population that travels between their northern breeding grounds in northwestern Canada and Alaska and their wintering areas throughout southwestern Canada, western United States, and north-central Mexico (Kochert *et al.* 2002) using a corridor along the Front Ranges of the Rocky Mountains (P. Sherrington, pers. comm., Kochert *et al.* 2002). The interface of the Rocky Mountains and the prairies present ideal conditions for migrating raptors, especially golden eagles, through prevailing westerly winds that create reliable updrafts along the foothills, all the way from north-central Mexico through western Canada (Tilly *et al.* 2002). The attractiveness of this route for spring migrating eagles is further enhanced by the abundance of ground squirrels (and prairie dogs in the United States) newly emerged from hibernation, carrion from spring calving, and migrating waterfowl (Tilly *et al.* 2002). Data from the Mount Lorette count site near Kananaskis Village (about 90 km northwest of the southern headwaters area) indicate that this migratory corridor is used largely by golden eagles in fall (88% of the total raptor flight) and spring (78% of the total raptor flight; Sherrington 2003), which probably represent 50-70% of the total golden eagle population (Sherrington 2002). In addition, there are indications that a segment of the fall migrating population of golden eagles crosses over the continental divide at an area just south of the Livingston Range and overwinters in southeastern British Columbia or continues in the inter-Rocky Mountain areas south (P. Sherrington, pers. comm.).

Golden eagles are wide-ranging raptors that are slow to mature and have a low reproductive potential. Most eagles do not acquire a territory until they are at least four years of age and have molted in their definitive plumage (Kochert *et al.* 2002). Breeding pairs requires a territory of about 20-30 km^2 and typically raise on average only one young per year for up to 15 years (Kochert *et al.* 2002). Golden eagle's reproductive output is linked to prey abundance prior to and during the breeding season and weather

conditions during the breeding season (Steenhof *et al.* 1997, McIntyre 2002). Northern populations are highly dependent of snowshoe hares and willow ptarmigan for successful breeding and their productivity is tied to their cycle of abundance (McIntyre and Adams 1999). Resident eagles in southwestern Alberta are believe to rely heavily on Richardson's ground squirrels in the prairie area, but mountain nesters become more dependent of Columbian and golden mantle ground squirrels and marmots as the breeding season progresses (P. Sherrington, per. comm.). Richardson's ground squirrels emerging in late winter and early spring in southern Alberta may also be a critical food source for adult birds wintering on the western prairies (Sherrington 2003). These prey enable them to build up pre-migration body reserves essential for their trip back to their northern breeding areas. This may be even more important in years of rapid decline of northern hares and ptarmigan. Data from the Mt. Lorette count site show a record number of golden eagles passing through in 2000 during a decline in prey species in the north, and lower numbers recorded at the site in years of high abundance of winter prey (Sherrington 2003). More adult golden eagles are able to winter north of the Mt. Lorette site in years of high prey abundance (Kochert *et al.* 2002, Sherrington 2003). Because of their late maturation, slow breeding rate, and low natural density, any increase in mortality or decrease in productivity related to human disturbance and development in the southern headwaters area may have a significant negative impact on the resident and the migrating populations of golden eagles.

10.1 Landscape Pressures

Golden eagles are generally considered sensitive to human disturbance and development (Britten 2001). Recreation and human activity in proximity of nests can cause breeding failures, although most evidence is anecdotal and correlative (Palmer 1988; Kochert *et al.* 2002). Along the Front Range of the Rockies in Wyoming, Colorado, and New Mexico, 85% of golden eagle nest failures were attributed to human disturbance (Boeker and Ray 1971). In the southern headwaters area, increasing off-road vehicle and backcountry use by outdoor enthusiasts may have an important impact on breeding golden eagles. In addition, Kochert *et al.* (2002) consider that over 70% of golden eagle recorded deaths are human-caused. Twenty seven percent are due to collision with vehicles or structures, 25% to electrocution, 15% to shooting, and 6% to poisoning (Kochert *et al.* 2002). Wind turbines in California are responsible for 28-43 golden eagle mortalities every year (Hunt *et al.* 1998, Kochert *et al.* 2002). At Altamont Pass, California, golden eagle is the fifth species most often killed by wind turbines and its local population is believed to be declining, in part due to windplant mortality (Erikson *et al.* 2001). Older technology, topography, and the unusually high raptor density in the Altamont Pass area are blamed for this high mortality level (Kingsley and Whittam 2003). During a two-year study involving 96 carcass surveys at the Castle River Windfarm in the southern headwaters area, only one raptor collision (an American kestrel) was observed (Kingsley and Whittam 2003). However, with the increasing number of wind turbines in the southern headwaters area, the potential for golden eagle collisions should not be overlooked. The proportion of golden eagles that died of various causes has not been compiled for the province to date (R. Quinlan, pers. comm.).

Immature birds may be at greater risk of mortality from the landscape pressures taking place in the southern headwaters area and elsewhere across the range of the species. Data from the Mt. Lorette count site over a seven year period (1994-2001) show an average ratio of immature to adults of 0.27 in the fall that is double of that in the spring (0.13; Sherrington 2003). This may suggests an annual average of 50% immature mortality during winter (Sherrington 2003), or a difference in migration routes (Kochert *et al.* 2002). However data from various studies across western United States support the greater mortality rate of immature birds during winter. Starvation was the most important cause of post-fledging mortality of juvenile golden eagles that were instrumented in Denali National Park (AK; Kochert *et al.* 2002). Moreover, of 52 golden eagle carcasses from power line surveys that could be aged in Idaho, Wyoming, Utah, Nevada, New Mexico, and Oregon, 54% were immatures, 40% were subadults, and 6% were adults. Of the 35 carcasses (all age classes) with known season of electrocution, 28 (80%) died during winter. Based on data from the Mt. Lorrette site, Sherrington (2003) suggested that wintering ranges might have a finite carrying capacity with relatively higher numbers of birds dying following years of high productivity. The wintering ranges of juvenile birds in southern Canada, western United States, and northern Mexico are facing large scale land use changes that combine with increases in threats from electrocution, illegal shooting and poisoning, and deliberate persecution of prey species such as ground squirrels and prairie dogs (Sherrington 2003).

Prey persecution and habitat alteration or loss can indirectly limit golden eagles. Secondary poisoning occurs when individuals consume prey killed or sickened by chemical used to protect crop or kill rodents (Kochert *et al.* 2002). Prey habitat loss to agriculture, and other forms of developments may also limit prey availability to nesting and wintering eagles (Kochert *et al.* 2002). In addition, Hunt *et al.* (1998) suggested that grazed grasslands might be favourable to foraging eagles by improving ground squirrel (and jackrabbit) densities and vulnerability. Managing rangeland for tall grass may therefore impede the eagle's foraging success. Urbanization and human-population growth have also rendered historically used areas unsuitable to eagles in southern California, New Mexico, and the Colorado Front Range (Kochert *et al.* 2002, DeLong 2004). In the southern headwaters area, invasion of shrubland on the grassland resulting from over a century of fire suppression (Murphy 1985) is likely to have improved jackrabbit habitat at the expense of ground squirrels. Nevertheless, foraging habitat may have been reduced in areas where succession has moved toward the forest. In heavily forested areas, Bruce *et al.* (1982) suggested that forest clearing might be beneficial to golden eagles by creating open foraging habitats. However, wildfires in the Snake River Bird of Prey National Conservation Area appear to have had the opposite effect on the local population by decreasing nesting success and the number of nesting pairs (Kochert *et al.* 2002).

11.0 CONCLUSION

At the interface between the mountains and the prairies and as and as an essential part of the Crown of the Continent ecosystem, the headwaters area of the Oldman River provides habitat and essential connectivity for movement and dispersal of several wide-ranging

carnivores, ungulates, and raptors between wilderness and protected areas to the north and to the south, and the western cordillera to the west (Blouin 2004). This diverse landscape is also reflected in the diversity of land use in the area. Increasing demand for natural resources, agricultural, recreational, industrial, and residential development and activities, and the associated growing population are putting increasing pressure on the remaining natural habitats and the sustainability of the wildlife populations that rely upon them (Blouin 2004). Because of their low densities, slow maturation, often low productivity, their requirement for wide areas, and their sometimes limited resilience to human-disturbed environments, cougars, lynx, fishers, martens, bears, wolves, ungulates, as well as golden eagles, are particularly vulnerable to individual and cumulative pressures exerted by humans in the southern headwaters area.

The increasing network of access roads and trails resulting from natural resource exploration and extraction, timber harvesting, and from residential and recreational development is of great concern for these species. Roads and trails and their use act as filters or complete barriers to movements of wide-ranging species and trigger behavioural changes. Direct mortality also occurs through collisions with vehicles, while indirect mortality results from legal or illegal hunting and trapping, and improved access to competing species or predators. Access is not only in the form of permanent roads or trails, but also in the form of temporary compacted snow trails created by snowmobiles and other off-road devices that transform the ecosystem by allowing access to competing or predator species that were otherwise restricted in an area.

Habitat loss, fragmentation, and degradation resulting from timber harvesting, agricultural, residential, industrial, energy, and recreational development and associated activities and infrastructures are also of particular concern in the southern headwaters area. Although timber harvesting is sometimes viewed as mimicking natural disturbances (Lee 1999), the pattern and rotation cycle of timber removal can result in an outright loss of habitat, a decrease in habitat effectiveness, and can contribute to isolating populations. This is even more important for species such as the fisher and the marten that are dependant on late seral stands of forest. Cattle grazing in wide-ranging species habitat also leads to subtle effects that contribute to decreasing habitat effectiveness of bears and ungulates through competition, introduction of alien invasive species, and vegetation changes. Elk farming further adds to habitat loss of some ungulates, but also brings a threat of introduced diseases that can have a profound impact in the predator-prey dynamic of the area. Fire management policies in the province since the early 1900s have also resulted in the loss and decreased effectiveness of grassland and forest habitats, in the loss of biological diversity, and in the increase in severity and impact of wildfires. In addition, most wide-ranging species are worried of the human presence and activities and will make spatial or temporal changes in their habitat use to avoid human encounters or access roads and trails and disturbed areas. This can increase their energetic requirements at some critical times of the year and/or result in avoidance of quality habitats and use of more marginal areas, which may further impair reproduction and survival of individuals. Of particular concern for the southern headwaters area is the increasing amount of off-road vehicles and recreationists that, with improving technology and unregulated access on public lands, are reaching higher elevations and remote places that used to function as

wilderness areas. Recreational pressure is expected to increase quite significantly in the area with the development of a major resort on Crowsnest Lake, where the hotel alone (excluding the condominium complex) is expected to draw between 90,000 and 120,000 visitors per year in the area (B. Bradley, pers. comm. *cited in* Anonymous 2005).

Habitat effectiveness is also decreased through persecution of prey species, such as the Richardson's ground squirrel, that are considered pests to farmers but are essential for pre-migratory energy build-up and reproduction success of raptors.

While individuals from some wide-ranging species can adjust to a certain level of human development and activities and take advantage of human attractants, conflicts arising from their adaptation often lead to the problem animals being removed from the area or killed. The perception of a threat by black bears and wolves is often sufficient to bring about the killing of those individuals that are seen in proximity of cattle and property by landowners or grazing lessees.

While the southern headwaters area presents several challenges to wide-ranging species, there are current initiatives and opportunities that should be embraced in order to minimize human pressures on their habitats and populations and to ensure their long-term sustainability in the area and genetic contribution to other populations that occur within the Crown of the Continent ecosystem and the surrounding landscapes. Among those are:

- The Yellowstone to Yukon (Y2Y) initiative has for mission "to restore and maintain landscape and habitat connectivity along 3200 km of mountains by establishing a system of core protected wildlife reserves that are linked by wildlife habitat and movement corridors. Existing national, state and provincial parks and wilderness areas will anchor the system, while the creation of new protected areas will provide the additional cores and corridors needed to complete it" (Wilcox *et al.* 1998). Y2Y is already working with several partners in southwestern Alberta and southeastern British Columbia to develop and implement a conservation plan for the Northern Crown of the Continent (see http://www.y2y.net/action/ccc-action.asp). This represents an opportunity to partner with Y2Y and get involved in the planning process for protected areas and wildlife corridors, and their implementation in the area.
- The Castle Wilderness area north of Waterton Lakes National Park is currently under a legislated access management plan that regulates the use of off-road vehicles. A similar legislated access plan should be developed for the remainder of the C5 forest reserve in the southern headwaters area. The plan should integrate road and trail restrictions or closures and activity restrictions in key wildlife areas and at critical times of the year, reclamation of sections of forestry or energy roads after operations have concluded, and should be implemented with genuine enforcement.
- The section of Highway 3 between the British Columbia border and Highway 507 is currently undergoing a functional planning study prior to its phased improvements leading to a freeway consistent with the National Highway Standard for interprovincial travel. The study report is expected to provide short to medium term

improvements of the existing highway and document the issues and concerns brought forward by stakeholders (Devos 2005). This study provides an opportunity to incorporate mitigation measures to the planning process to maintain and improve wide-ranging species connectivity through integration of various wildlife crossing structures (e.g., overpasses, underpasses, drift fences, etc.), but also to minimize development into key habitats and disturbance during critical times.

- Two projects supported by the Wildlife Conservation Society Canada are currently underway in the Crowsnest Pass region to ensure the survival of large carnivores. One project aims at identifying critical core areas and linkages for carnivore conservation in the 40,000 km^2 study area using habitat modeling and wildlife surveys and produce guidelines for conservation action at local and regional levels (see http://www.wcscanada.org/wcsc-home/wcsc-main/wcsc-carnivore_conservation_in_crowsnest_pass). A second project in collaboration with the University of Alberta uses detailed movements of grizzly bears and cougars equipped with Global Positioning System collars and resource selection function models to identify and assess the most suitable locations for corridor placement (Chetkiewicz 2002).

- In addition to planning for wildlife corridors, key wildlife areas should also be identified within the boundary of the Municipality of Crowsnest Pass and discussions should be undertaken with the municipal council to protect those areas from development.

- In 2002, the Alberta Endangered Species Conservation Committee has recommended to the Minister of Sustainable Resource Development that the grizzly bear be listed as "Threatened" under Alberta's *Wildlife Act* (AB SRD 2005). The Alberta Grizzly Bear Recovery Team was initiated in October 2002. The Team developed a grizzly bear recovery plan that has been submitted to the Minister of Sustainable Resource Development along with a departmental response to the plan by the executive director of the Wildlife Management Branch (D. Hobson, pers. comm.). If approved, the plan calls for the creation of multi-stakeholder regional teams responsible for implementation of specific recovery actions. Participation in the southwestern regional team would provide an opportunity for involvement in the recovery and conservation of the grizzly bear in the southern headwaters area.

- Alberta Sustainable Resource Development has developed a draft management plan to guide the forest management activities for the next 20 years in the C5 Forest Management Unit. This unit, which extends north of Waterton Lakes National Park and south of Kananaskis Country (Government of Alberta 2005), encompasses the forested region of the southern headwaters area. The plan is scheduled to come into effect in May 2006 and is intended at providing forest management strategies to ensure a continuous supply of coniferous timber, while minimizing the impacts of forestry operations on non-timber resource values, land uses, and human activities (Government of Alberta 2005). Of particular interest, the management plan seeks to sustain the health and integrity of forest ecosystems by ensuring that natural processes are allowed to operate unimpaired or are emulated. Where possible, natural disturbances will be emulated through management actions if natural disturbance

events, such as wildfires, are controlled or eliminated (Government of Alberta 2005). Although the public consultation period on the draft plan is nearing the end at the time of this report, the C5 Forest Management Plan embraces the principle of adaptive management. Public involvement will be sought during the implementation phase of the plan. According to the plan, "an open, transparent and consultative approach will be followed, allowing affected participants to influence future decision-making" (Government of Alberta 2005). In addition, amendments to the plan will be considered at five-year intervals based on stewardship recommendations made by Alberta Sustainable Resource Development following results from monitoring programs, research projects, public participation, improved resource management approaches, etc. (Government of Alberta 2005).

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